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PHYSICAL EXAMINATION AND PREVENTIVE MEDICINE 1094-9194/99 $8.00 + .00

CLINICAL EVALUATION OF RODENTS

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Many small rodents are kept as pets, including the rat *(Rattus norvegicus)*, the mouse *(Mus musculus)*, the gerbil *(Meriones unguiculatus)*, the Syrian hamster *(Mesocricetus auratus)*, and the guinea pig *(Cavea porcellus)*. Recently, the dwarf hamster, *Phodopus sungorus* and Chinese hamster, *Cricetulus griseus*, have become more popular. These pets require little space, are relatively inexpensive to maintain, and provide an excellent starting point into pet ownership for children. As rodents gain popularity, veterinary clinicians are more frequently being called on to provide basic information and medical care for these animals. This article is an effort to provide introductory information for the common domestic rodent species. More in-depth information can be obtained from references listed at the end of the article.

ANATOMIC FEATURES

Mice, rats, hamsters, gerbils, and guinea pigs are all members of the order Rodentia, the largest order of mammals. These species all have several features in common. They are usually small and quadrupedal. Rodents are hindgut fermenters with a predominantly gram-positive gut flora, and most exhibit coprophagic behaviors. They are nocturnal in nature, and certain members of this order, most notably hamsters, may hibernate or aestivate. There are four hypsodontic (open-rooted) incisors in all the species, but the molars are hypsodontic only in the guinea pig. There is a prominent diastoma between the incisors and cheek teeth.

From Laboratory Animal Services, Thomas Jefferson University, Philadelphia, Pennsylvania

Although many of these pets have features in common, there are also several distinctions. The hamster has extensive cheek pouches in which it can store a great deal of food. Gerbils are desert dwellers and have adapted to periods of water deprivation; therefore, they may normally excrete as little as two to three drops of urine per day. Unlike other common pet rodents, guinea pigs have a mandatory need for an extrinsic source of dietary vitamin C. Therefore, although they are similar, the veterinarian should be familiar with a few of the idiosyncratic features of each of these species.

The eyes of many rodents normally appear almost exophthalmic in nature. Deep to the globe is a glandular structure named the harderian gland. This structure produces porphyrin secretions that give tears a reddish tinge. If the animal is under duress, the secretions may become evident in the periorbital and perinasal region, causing owners to assume the animal is bleeding. Coagulopathies can exist in rodents (especially if there is any question of exposure to rodenticides); therefore there is good reason to differentiate between blood and porphyrin. Porphyrin pigmentation can be differentiated from blood by exposing it to an ultraviolet light under which conditions the porphyrin exhibits a red fluorescence.

Rodents do not possess sweat glands, but many do have scent glands. The most prominent of these are seen in the gerbil. There is a distinct area on the ventrum that is the ventral marking gland, most easily seen in the male. The hamster has bilaterally symmetric flank glands on the dorsum. Both of these glands are sebaceous in nature and rarely cause clinical problems. Yet if the clinician is not aware of these normal features, they may be easily mistaken for some form of dermatopathy.

It is important to have some basic knowledge of the reproductive anatomy and physiology of the various species of rodents. Because of the prolific nature of these animals, veterinarians are frequently called to provide assistance in population control. Sexing rodents is easily accomplished. Males can be differentiated from females by their increased anogenital distance (Figs. 1*A* and *B*). It is important to realize that rodents have open inguinal rings and can retract their testes into the abdomen under duress. The rat has a rather pendulous scrotum, and it is not uncommon for owners to assume the testes are abnormal masses. The female rodent has a urethral orifice that is externally distinct from the vaginal opening. This feature allows the clinician to differentiate between a discharge of urinary tract origin and one from the reproductive tract. Rats and mice have extensive mammary tissue that can extend from over the shoulders and caudally to the inguinal region. Pathology of these tissues can occur in either species and in any of these areas.

Most of the rodents give birth to altricial young with the exception of the guinea pig. After a protracted gestation period (approximately 63 days), the guinea pig gives birth to precocial young that can survive

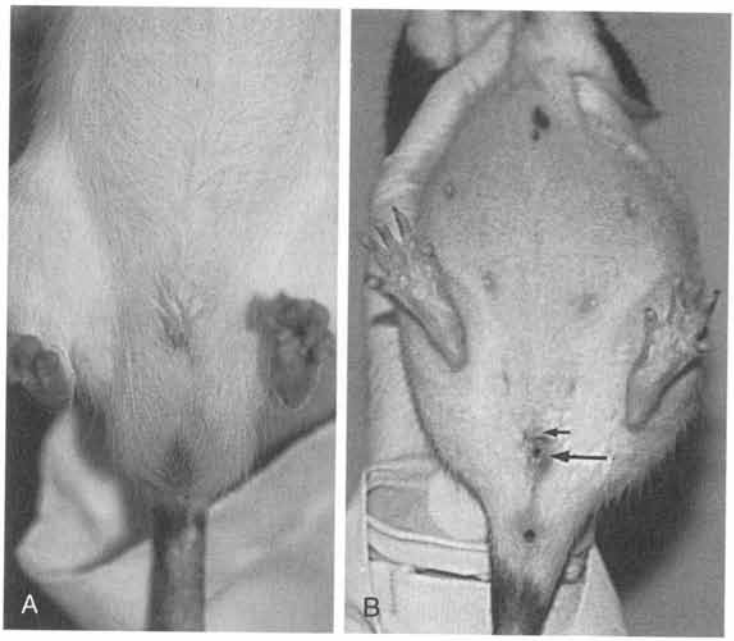

Figure 1. *A*, External genitalia of the male rat. Note the pendulous scrotum. *B*, External genitalia of the female rat. Note the prominent nipples and decreased anogenital distance when compared to the male rat. In female rodents, the urethral orifice *(small arrow)* is distinct externally from the vaginal opening *(large arrow)*.

without the sow. Owners should be made aware that rodents commonly exhibit a fertile postpartum estrus that can occur within hours of parturition. Overpopulation can occur quickly if owners are not properly educated.

HISTORY

Obtaining a thorough history is crucial when dealing with small pet rodents. By asking the right questions you may be able to narrow the differential diagnosis significantly. First, it is important to ascertain where the pet was obtained. Rodents can be obtained from a variety of sources, including pet stores, professional or nonprofessional breeders, and laboratory animal facilities. It is not unusual to see some of the various immunocompromised animals, including nude mice and rats, infiltrating the pet population. Additionally, ask who the primary owner is and how long he or she has owned the animal. Many educational facilities, including preschools and elementary schools, maintain small rodents in their classrooms, and many children have rodents as their

first pets. If a child owns the pet, it may be important to ascertain who is responsible for the care of the animal. Without adult oversight, young people may not be mature enough to ensure proper care of the animal.

Ask questions about the housing of the pet. This should include the immediate or primary housing (i.e., cage) as well as the room in which the animal is kept. Some rodents, especially guinea pigs, are exquisitely susceptible to temperature fluctuations, which may compromise their health status. Rats and mice easily succumb to heat stroke. Ideal room temperature for most rodents is 64° to 79°F (18° to 26°C) with an average humidity of 45% to 55%.[9]

Contact with any other pets, including other members of the same species as well as other species, should be explored. Query the owner as to recent additions or deaths of other pets. Many times this is superfluous information. However, since mixing different species can result in serious disease (e.g., guinea pigs acquiring pneumonia from asymptomatic rabbits due to *Bordetella*), this information may assist clinicians in their diagnostic and therapeutic plan. In addition, various ectoparasites can be acquired from other pets. It is not uncommon to treat rodents for fleas obtained from cats and other household occupants.

Dietary information is always important. Fortunately, many small rodents can survive on less than optimal diets, but the guinea pig is an exception. Guinea pigs are incapable of synthesis of vitamin C because of an inability to produce L-gulono-gamma-lactone oxidase, the enzyme that converts glucose to ascorbic acid. Vitamin C must be supplied in the guinea pig's diet, and deficiencies may be seen in animals fed outdated store-bought food. Therefore, it is not only necessary to identify the diet but also its source. It is unusual for the owner to know the milling date of the diets, and this would be the most useful information. Most conventional guinea pig diets only supply adequate levels of vitamin C when used within 3 months of their milling date. Some formulations are becoming available that may be adequate for 6 months past their milling date. If the owner supplies any dietary supplementation, this should be noted. Owners may be reluctant to divulge this information, yet in many cases they may be actually providing necessary nutrients by unconventional food items. Alternately, they may be supplying detrimental foodstuffs.

The source of water and how it is supplied to the animal is important. Usually water is presented in a small crock or in a water bottle with a sipper tube. If the pet has been recently acquired and the method of water supply has changed, the animal may become dehydrated because of an inability to understand the mechanism of water delivery. This may not be apparent to the owner. Guinea pigs are known to be neophobic and may be extremely susceptible to this problem.

The owner should be queried as to the previous health history of the pet. In many cases, the age given is approximate. The average life span of the small rodent species is given in Table 1. Many pets will not be presented to a veterinarian until they are geriatric, and the owners may be unaware of the short longevity of many rodents, especially mice,

Table 1. NORMAL PHYSIOLOGIC VALUES FOR SELECT RODENT SPECIES*

Characteristic	Guinea Pig	Rat	Gerbil	Hamster	Mouse
Average Life Span (yr)	5–6	2–3	3–4	1.5–2	1.5–2.5
Adult Body Weight (g)					
Male	900–1200	250–500	45–130	90–130	20–40
Female	700–900	225–325	50–55	95–130	20–60
Body Temp (C)	37.2–39.5	37.7	38.2	37.6	37.1
Heart Rate (bpm)	240–310	300–500	250–600	300–475	425–700
Age of Sexual Maturity (wk)					
Male	12	4–5	9–18	8	6
Female	8	4–5	9–12	6	6
Gestation (d)	59–72	21–23	23–26	15–18	19–21
Weaning Age (d)	21	21	21–28	19–21	18–21

*These values were compiled from sources on the reference list.

hamsters, and rats. Alternately, guinea pigs may live as long as 8 years, thus surprising many owners.

The reproductive history of the pet should be explored. Many rodents are quite prolific, and if they are pair-housed, a single pair of mice can generate approximately 50,000 progeny in one year! It is important to determine whether any litters have been born and their fate. This is especially true for the guinea pig for reasons that will be discussed later in the article.

Any previous disease problems or treatments should be noted in the record. These should include those diagnosed and treated by a veterinarian as well as those treated by the owner without veterinary consultation. Many owners return to the source of the pet for advice. Pet-store employees and breeders often attempt to assist the owners by recommending over-the-counter medications or home remedies. These are not necessarily innocuous therapeutic options. Many rodents, most notably the guinea pig and hamster, are exquisitely susceptible to antibiotic toxicities and dietary upsets.

The last portion of the history should include the immediate cause for presentation. The initial presenting sign, duration of clinical signs, and any change noted since onset should be noted as well as any therapy undertaken. Within this group of animals, the guinea pig tends to be the most fragile. Respiratory disease is common in these animals, and the initial clinical sign may be as subtle as a change in posture when resting. Signs as subtle as these, if missed, may result in a lack of positive response to prescribed therapy and, ultimately, an unfavorable outcome.

PHYSICAL EXAMINATION

The initial part of the physical examination should be done while the animal is unrestrained. Behavioral observations as well as respiratory

rate can be obtained prior to handling. Any fecal material or urine present in the cage should be examined for abnormalities. Polyuria is not uncommon in rodents with renal compromise, and often this can be observed prior to handling the pet. Evidence of blood or porphyria may be seen in the cage. Red porphyrin pigmentation is often seen in stressed rats and may be mistaken for blood.

If the animal is presented in its home cage, check the enclosure for any sharp edges that may provide either a danger to the animal or an escape route for small rodents. Make note of the type of bedding used and whether any odors are evident. Infrequent bedding changes may allow for a buildup of ammonia odors that serve as respiratory irritants and may predispose the animal to respiratory disease. Soft wood bedding has also been shown to increase respiratory infection rates.[3]

The least amount of restraint necessary to accomplish the physical examination is ideal. Although many of these small pets are quite tractable, they may become agitated when restrained. The guinea pig is extremely docile and tends to either freeze or circle when handling is attempted. This animal may be restrained by simply placing it on a table facing the examiner with the owner placing one hand on the rump to prevent the animal from backing up. Hamsters have a reputation for being pugnacious and may require more restraint. They are generally restrained with the scruff technique. It is important to realize that hamsters have extensive cheek pouches and if not adequately scruffed, can turn on the examiner and inflict damage. Many pet rats and mice need only be held on a cloth-covered table while being examined. However, if they are somewhat obstreperous, mice can be scruffed (Fig. 2). Rats are best restrained with an over-the-back technique. Place your index and middle fingers down along the sides of the rat's head with your thumb and ring finger under the forelegs. Place your index and middle finger cranial to the front legs for a better grip. Use your thumb and

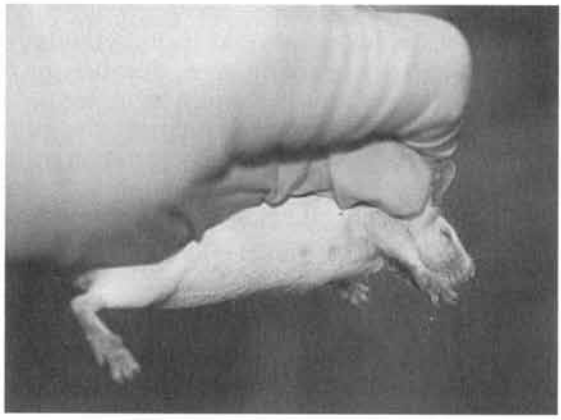

Figure 2. Scruffing technique used to restrain mice and hamsters.

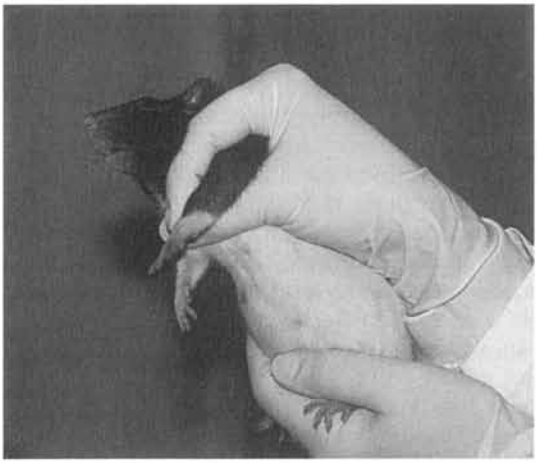

Figure 3. Proper restraint of the rat. It is preferable to use this technique with rats rather than scruffing them.

other fingers to support the chest lightly (Fig. 3). Gerbils tend to be quite docile and usually require little restraint. They are prone to tail slip, so if the tail is grasped to maintain control of the animal, make sure to grasp it near the base. This species is also prone to seizures when stressed. Care should be taken to decrease the amount of stress induced by restraint and examination.

The physical examination of small rodents should be conducted in the same manner as that of any animal. First, obtain an accurate weight. For the smaller pets, a gram scale is imperative, as mice may weigh as little as 15 g. Listed in Table 1 is the average adult weight of several common rodent species.

If the temperature of the animal is going to be taken, it should be done at this time, before the animal is very excited. With the advent of plastic, flexible digital thermometers, it is not recommended to use glass thermometers. These small pets can react quickly, which may result in breaking the thermometer and thereby creating more problems. The clinician should also access the risk/benefit ratio in taking the temperature of these animals. Most veterinarians do not typically obtain body temperatures on mice, rats, hamsters, and gerbils. Normal body temperatures are listed in Table 1 for reference.

Clinicians should proceed with the physical examination after whatever pattern they have established with more traditional species. Many clinicians initiate the examination at the head and work caudally. Initially, the fur and skin should be closely examined. Examine the eyes, ears, and nose for any abnormalities. Any discharge, serous or otherwise, should be noted. Respiratory disease is a common presenting sign in rodents, and presenting signs may be subtle, especially in guinea pigs. An ophthalmic examination is challenging in the small species, but if

there are indications of ocular involvement, any abnormalities should be noted. If a more thorough workup is indicated (such as fluorescein staining), this should be completed after the initial physical examination is completed, as many small rodent species have limited patience for the examination process. Similarly, an oral examination should be done; however, since it is quite distressing to these pets, it should be performed at the end of the physical.

Observe the fur coat and note any irregularities. Lesions limited to the fur need to be delineated from those affecting both the fur and the skin. The differential diagnoses for these two clinical entities are not the same. If there is a pattern to the alopecia or skin lesions, this should be noted as well. In addition to examining the fur and skin, it is important that the clinician gently feel for any obvious external masses. Starting at the head, palpate the lymph nodes and mammary glands. Often, this can be accomplished under the guise of stroking and petting the animal. Note any irregularities or asymmetry.

The rest of the physical examination can be conducted as with larger domestic animals with the realization that auscultation and abdominal palpation may be more challenging to interpret because of the diminished size of the patient. Because of the size of the patient, thoracic auscultation is best accomplished with a pediatric stethoscope. The normal heart rate may be challenging to count in these animals as the normal resting heart rate in a mouse can approach 700 beats per minute.[4] Cardiac murmurs are difficult to auscult, but it is feasible to characterize the rhythm. Cardiac abnormalities are not uncommon in small rodents; however, most of these findings are not detected antemortem. Geriatric hamsters and certain strains of mice are prone to cardiomyopathy and may present with nonspecific signs such as lethargy.

Respiratory disease is a common clinical disease in many of these animals, and careful attention should be paid to auscultation of the lung fields. Rats commonly have subclinical disease caused by *Mycoplasma pulmonis*, which when exacerbated, can become life threatening. Crackles and wheezes are easily heard often without the benefit of a stethoscope. Although guinea pigs are exquisitely susceptible to both bacterial and viral pneumonia, auscultation is often unrewarding in this species even when significant disease is present.

Abdominal palpation has its limitations in these animals, but attempts should still be made to check for any obvious masses. Pregnancies may be palpated as well as uterine masses in rats and guinea pigs. It is important to check the perineal area, keeping in mind that rodents have open inguinal rings and that males may retract their testicles into the abdominal cavity. Evidence of fecal or urine staining should be noted. Polyuria and diarrhea are common clinical problems in rodents.

Examine the extremities for any abnormalities. Pododermatitis or sore hocks can be seen in many of the rodents. These lesions are typically somewhat circular and scaly in appearance. Depending on the severity of the condition, there may be evidence of osteomyelitis. Continue the

examination by checking the tail of those species that have one. Trauma to both the tail and digits is common but is rarely of clinical significance.

The last procedure should be the oral examination. This is accomplished with the use of an otoscopic cone. Most animals resent this examination, so the clinician has to exhibit a fair amount of patience. If the animal is in a compromised state and exhibits a great deal of stress during attempts at an oral examination, it should be delayed until such time as the patient is more stable. Incisor problems are most common in most small rodents, with the exception of guinea pigs. It is crucial to check the molars in guinea pigs as they can often present with malocclusive disease.

COMMON DIFFERENTIAL DIAGNOSES

Nonspecific Signs of Disease

It is important for the clinician to realize that many pet rodents present with nonspecific signs of disease. Anorexia, rough hair coat, hunched appearance, and lethargy may be the only clues with which the clinician may be presented. The most common problems seen in these animals involve dermatopathies, gastroenteropathies, and pneumonias. The most prevalent differentials are listed below according to the organ system affected.

Cutaneous Signs of Disease

Many rodents present with lesions involving either the hair coat or the skin. Lesions limited to the hair have a different set of differential diagnoses than those involving the skin. Some of the most common lesions involving only the fur are rather easily diagnosed. Barbering is a common problem in group-housed mice and, occasionally, guinea pigs. The dominant animal in the cage will chew off the whiskers and hair around the muzzle and eyes of cage mates (Fig. 4). Generalized alopecia may be caused by the presence of ectoparasites. Fur mite infestations, which are diagnosed with a hand lens to examine the fur, are a common problem in mice and rats. In addition, various mange mites are known to infest rodents. Demodectic mange has been seen in rats, hamsters, and gerbils. Sarcoptic mange has been diagnosed in guinea pigs. Lice and fleas may also result in damage to the hair coat.

There are a few clinical entities that may involve both the hair coat and the skin. Dermatophytosis has been identified as a problem in guinea pigs; usually, it is caused by *Trichophyton mentagrophytes* or *Microsporum canis*.[5] Usually, the head is affected with the pinna exhibiting a scaly appearance typical of ringworm in other species. A patterned alopecia, bilaterally symmetric along the flank region, has been associated with endocrinopathies in the guinea pig and hamster (see pages 20

Figure 4. Alopecic lesions on the head of a mouse due to barbering by a cagemate.

and 21). In addition to the alopecia, there may be hyperkeratosis and pigmentation of the skin.

Dermal involvement usually implies a different set of clinical entities. First, any possible source of trauma should be ruled out, including self-abrasion from caging or feeders or injury from cage mates. Trauma from cage mates is most commonly seen in group-housed mice, although hamsters have been known to exhibit this problem as well (Fig. 5). It is seen less frequently in rats and gerbils. Lesions are commonly seen around the urogenital region in group-housed males.

Mice may also exhibit a hypersensitivity reaction to the fur mite, *Myobia musculi*. This typically produces a lesion that may vary from dry and scaly to ulcerative. The lesion usually involves the back, neck, head, and shoulders. Ulcerative dermatitis may be seen in rats, with *Staphylococcus aureus* typically being cultured. The exact cause of the lesion is unknown and may be relatively refractory to topical or parenteral antibiotic therapy. The owners should be given a guarded prognosis.

Figure 5. Bite wounds inflicted on the dorsum of a mouse by a dominant male cagemate.

Gerbils are known to exhibit a facial dermatitis that is limited to the nasal region. It is thought that the lesion is caused by an inordinate amount of secretion from the harderian gland, resulting in facial eczema.

Cutaneous masses are usually abscesses or neoplasms. Abscesses are commonly found in small rodents owing to opportunistic pathogens such as *Staphylococcus aureus, Pasteurella pneumotropica,* and *Streptococcus pyogenes.*[5] Guinea pigs may exhibit a disease entity referred to as lumps or cervical lymphadenopathy, which is characterized by abscessation of the cervical lymph nodes, usually by *Streptococcus zooepidemicus,* Lancefield Group C or (less likely) *Streptococcus moniliformis.*[4] As *Streptococcus zooepidemicus* is a component of the normal oral flora, oral trauma as a result of brittle feed or dental pathology may allow for an ascending infection that colonizes the lymph nodes.

Tumors are also common, especially in aging pets. Mammary tumors are common in both rats and mice. The most common tumor in rats is a mammary fibroadenoma, a benign neoplasm. Although these tumors may achieve quite impressive size, they rarely pose any problem other than a physical disability. In mice, mammary adenocarcinoma is common and carries a poor prognosis. Usually, these lesions are aggressive and may invade deeper tissues, making surgical excision challenging. Because of the extensive nature of mammary tissue in rodents, mammary masses may be located anywhere from the scapular area to the inguinal region.

Ocular Signs of Disease

Diseases of the orbit as a single entity are uncommon in pet rodents; however, often abnormalities may be noted that are indicative of a more global problem. Conjunctivitis is most commonly bacterial in origin in guinea pigs; however, it may be indicative of a larger problem involving vitamin C depletion or respiratory disease. Many owners will present their pets for periorbital hemorrhage, when in fact it is chromodacryorrhea or red tears. As previously mentioned, this response is nonspecific and is induced by stress. Such stressors can be as simple as inappropriate environmental temperatures or overhandling or as complex as terminal renal disease. The clinician needs to investigate further to delineate the cause of the stress.

Rats are the carriers of sialodacryoadenitis virus, a corona virus that infects the lacrimal glands. Clinical signs include sneezing, squinting, photophobia, blinking, chromodacryorrhea, and cervical swelling. Although this virus is extremely contagious, rats usually recover without the need for therapeutic intervention.

Cataracts are seen in some of the geriatric rodent species and usually pose no significant problems. Note that transient cataracts can develop in an anesthetized rodent. The exact mechanism of this is not yet described; however, the cataracts disappear as the animal recovers from anesthesia. It is prudent to use an ophthalmic lubricating ointment when anesthetiz-

ing these pets as corneal injuries can occur while the patient is anesthetized.

Exophthalmos has been noted in hamsters, usually as a result of trauma, infection, or overzealous restraint. The proximate cause should be determined and appropriate therapy initiated. Immediate treatment of the condition usually allows for a good prognosis.

Respiratory Disease

Rats commonly have subclinical disease caused by *Mycoplasma pulmonis*, which can be exacerbated. *Streptococcus pneumoniae*, *Corynebacterium kutscheri*, cilia-associated respiratory (CAR) bacillus and Sendai virus can also cause pneumonia.[4, 5] It is common to see more than one agent involved in an outbreak of clinical disease. Owners should be made aware that treatment will not result in eradication of the offending pathogens but that it squelches the acute clinical signs. Recurrences are common, especially in geriatric patients.

Guinea pigs are exquisitely susceptible to both bacterial and viral pneumonia. *Bordetella bronchiseptica* and *Streptococcus pneumoniae* often cause bacterial pneumonia in guinea pigs.[6] Both of these organisms are carried innocuously by many species, including humans. Increased levels of stress are most likely the precipitating cause of bacterial pneumonia in guinea pigs. Aggressive antibiotic and supportive therapy should be initiated, as guinea pigs readily succumb to bacterial pneumonia. An adenovirus has been implicated as the causal agent of viral pneumonia in this species.[6] It carries a poor prognosis as well, with most animals dying acutely.

Gastrointestinal Disease

Diarrhea is a common presenting clinical sign in small rodents, and the prognosis should always be guarded. The gut flora is easily upset, and as is true in rabbits, may be difficult to reestablish. The origin of diarrhea may be bacterial, viral, dietary, parasitic, or iatrogenic. Guinea pigs and hamsters are exquisitely susceptible to gastrointestinal upset, whereas rats and mice are more tolerant. As the gut flora is predominantly gram-positive, antibiotics that affect that spectrum may induce diarrhea. Problematic antibiotics include the penicillins, first-generation cephalosporins, macrolides, tetracyclines, and bacitracin. However, any antibiotic may induce overgrowth of *Clostridium difficile*, thus creating antibiotic-associated enterotoxemia. Supportive treatment should be provided, but response to therapy is frequently not very rewarding.

Salmonella typhimurium, *Salmonella enteritidis*, *Yersinia pseudotuberculosis*, *Clostridium perfringens*, *Escherichia coli*, *Pseudomonas aeruginosa*, *Listeria monocytogenes*, and *Citrobacter* may all cause diarrhea in various rodent

species.[4] Transmission is usually fecal oral, and treatment is supportive. Culture and sensitivity may assist in directing therapy.

Tyzzer's disease commonly affects hamsters, gerbils, and guinea pigs. The causative organism is *Clostridium perfringens,* and typically animals present with diarrhea and acute death. Treatment is unrewarding.

Hamsters can be afflicted with a condition commonly referred to as wet tail. The causative organism is a newly described organism, *Lawsonia intracellularis,* which causes a proliferative ileitis.[5] It is predominantly seen in newly weaned pups. If antibiotic and supportive therapy is successful in achieving recovery, sequelae seen in adults include intestinal obstruction and other enteropathies.

Although viral causes of diarrhea have been reported in guinea pigs, rats, and mice, they are usually not problematic in the pet population. Various parasites are responsible for diarrhea, including protozoa such as *Cryptosporidium.* More commonly, coccidiosis is diagnosed. Rarely do these agents cause clinical disease except in immunocompromised animals.

Fecal impactions can occur in geriatric guinea pigs. This is most commonly seen in older boars that present with large accumulations of feces in the rectum. The fecal material should be gently removed and the skin treated if irritated.

Malocclusive disease should be considered in all rodent species that present with weight loss and anorexia. Guinea pigs have hypsodontic incisors, premolars, and molars, any of which can overgrow. The other small pet rodents have only hypsodontic incisors, so overgrowth owing to malocclusion is usually obvious. Tooth root abscesses may also occur and may be challenging to diagnose. Radiographs of the head and mouth are usually diagnostic. If accessible, dental radiographs provide the most useful diagnostic tool.

Urogenital Disease

Although many pet rodents present with signs of disease affecting the renal system, different disease entities tend to be prevalent in each of the different rodents. Guinea pigs are commonly affected with urinary calculi, yet other rodents rarely have this form of disease. Congealed ejaculum, inguinal sebaceous secretions, and dirty bedding can all contribute to urethritis or urethral obstructions in guinea pigs, especially older boars. Geriatric hamsters often present with polyuria accompanied by weight loss that is most commonly caused by renal amyloidosis. The prognosis is poor for these animals. Rats may occasionally be seen that exhibit polyuria and weight loss. Chronic renal disease is seen in these animals as well as guinea pigs as they approach an aged state.

Reproductive problems are occasionally seen in rodents, with guinea pigs again being the most problematic. Female guinea pigs may experience dystocia if not bred before the age of 6 months. Relaxin, a hormone,

causes the fibrocartilaginous public symphysis to disintegrate during the last half of pregnancy. Prior to parturition, the gap may be easily palpable and can approach 15 mm.[5] If a pregnancy has not occurred prior to 6 months of age, the tissues are not sensitized to relaxin, and separation may not occur. If the sow prior to this age achieved a successful pregnancy, this is not an issue. Pregnancy toxemia is also a significant clinical entity in this species as are ovarian cysts. Ovarian cysts may result in a bilaterally symmetric alopecia.

Uterine prolapses are not uncommon in the smaller rodents (Fig. 6). Rats may present with bloody vaginal discharge caused by endometrial hyperplasia that may be significant enough to result in anemia. Cases of pyometra caused by *Pseudomonas aeruginosa* have been reported.[10] With ovariohysterectomy, these animals have a good prognosis.

Litter wastage is a common problem. Stress, real or perceived by the animal, can result in cannibalism. Most small rodents have altricial young, with the noted exception of the guinea pig. It is important to stress to the owners that the dam and pups not be disturbed in the few days surrounding parturition. However, this is no assurance that the litter will be successfully raised.

Miscellaneous Signs of Disease

Endocrinopathies are commonly encountered in small rodents. Guinea pigs, as well as certain strains of mice and rats, can develop

Figure 6. Uterine prolapse in postpartum mouse.

diabetes. Affected animals show weight loss, polydipsia, polyuria, and glycosuria. Hamsters have been documented to have clinical signs compatible with adrenal hypercorticism, including polydipsia, polyuria, polyphagia, alopecia, and hyperpigmentation. Currently, a successful treatment regimen still does not exist.[5]

Inadequate diets, outdated products, or periods of anorexia can result in clinical signs of hypovitaminosis C within 2 weeks of deprivation. Since vitamin C deficiency results in defective collagen production, various presentations may occur. The initial presenting sign may be as subtle as reluctance to move. Other signs can include various nonspecific findings such as anorexia, diarrhea, loose teeth and malocclusion, hemorrhage (particularly in joints and gingiva), and indications of pain. Radiographs indicating pathologic fractions or enlarged long-bone epiphyses and costochondral junctions in conjunction with these clinical signs are considered diagnostic; however, response to therapy is conclusive.

Gerbils are susceptible to epileptiform seizures that may be exacerbated by novel stimuli. This susceptibility appears to be inherited and usually first presents in weanling animals. However, many gerbils outgrow the condition.

Head tilts in rodents can result from otitis media or interna and are usually caused by bacterial infections. The rat is commonly afflicted with a benign pituitary adenoma that may result in a head tilt or in generalized incoordination. Antemortem diagnosis of either of these lesions is challenging.

Heat stroke commonly affects small rodents. In addition to rabbits, these small animals easily succumb to warm temperatures. Unfortunately, many of them present when it is too late to have a successful outcome.

PREVENTION OF DISEASE

Compared with other common exotic pets, small rodents are quite hardy. If the animal is fed an adequate diet, provided with potable water, and kept in a safe, comfortable environment, many of these pets fare well. Probably the most important criterion for maintaining the long-term health of the pet is to obtain a healthy animal at the onset. It is important to stress to the owner that caging is of the utmost importance not only in confining these animals but in preventing other possible predator species in the household from devouring them. It is also imperative that the cage environment be kept as clean as possible. A lack of cleaning results in a buildup of odors, some of which may predispose to disease. Currently, there are no vaccinations recommended for these animals; however, yearly physical examinations are suggested. Some of these pets quickly become geriatric, and client education is as important as the examination of the pet.

ZOONOSES

Zoonotic infections transmitted by pet rodents are rare. It is important to clarify that this is only the case if we delineate between domestic rodents and wild rodents kept as pets. Wild rodents can transmit many diseases not seen in the domestic population, and caution should be exercised when dealing with these animals.

Most of the health problems encountered by owners from pet rodents revolve around allergies and bites. Allergies to rodent dander and urine are common. Bites are capable of transmitting several bacterial infections, the most prevalent being *Pasteurella multocida.* Note, however, that most human cases of pasteurellosis are the result of cat and dog bites, not rodent exposures.[2]

Rat bite fever (RBF) is the result of infection with *Streptobacillus moniliformis* or, less commonly, *Spirillum minus.* Note that there are confirmed cases of RBF in which the child was infected by allowing her pet rat to lick her tongue, thereby indicating that a bite is not necessary (personal experience). RBF is an uncommon occurrence, and physicians frequently query the veterinary clinicians about this disease. Since these organisms are a component of the normal flora of the nasopharynx of most rats, definitive diagnosis requires culture of the organism from human blood or tissue. Many physicians may choose to initiate therapy while awaiting culture results. The decision as to whether the family chooses to relinquish ownership of the pet is difficult, and all the veterinarian can do is supply factual information for consideration.

Rodents may also harbor *Salmonella, Yersinia, Acinetobacter,* and *Campylobacter.*[1] Although these agents are capable of causing disease in humans, it is not a common event and usually occurs in an immunocompromised individual.

There are few viral diseases of zoonotic concern in domesticated rodents. Lymphocytic choriomeningitis (LCM) is a viral disease known to affect several rodent species, most notably mice and hamsters. There has been an outbreak of disease in humans in the United States that was tracked to one particular hamster-breeding facility. Other than that event, the disease in man is rarely seen in the United States.[4]

Hanta virus can cause a variety of clinical syndromes in humans, including hemorrhagic fever with renal syndrome or more recently, pulmonary syndrome. Note that although rodents are capable of serving as a reservoir of the virus, the outbreaks of disease have been traced to wild rodents and not domestic pets.[8]

Rodents are capable of developing clinical rabies. The likelihood of this occurring is rare because of the lack of exposure of most pet rodents to other animals harboring the disease. Owners should be properly educated, as should any public health officials who contact veterinarians for information.

Various dermatopathies in rodents have zoonotic potential. These include dermatophytoses, most commonly as a result of *Trichophyton menaogrophytes.*[7] Lesions on pets are commonly on the head, and guinea

pigs may exhibit visible lesions on the pinna. Other rodents may have no visible lesions. Sarcoptic mange can be transmitted from rodents to humans. The causative agent in most cases is *Trixacarus* spp.[7]

Endoparasites of rodents rarely are zoonotic with the exception of *Hymenolepis nana* and, less commonly, *Hymenolepis diminuta*.[4] The route of infestation is via fecal–oral transmission. Children are usually the ones affected, and the infection is subclinical in most cases.

SUMMARY

The clinical examination of small rodents is like that of more conventional pets in that the same systematic approach is used to arrive at a problem list. The difference with these species is that their diminutive size, high metabolic rate, and lack of patience may be problematic for the clinician. With continued practice and patience, veterinarians can begin to feel comfortable in adding small rodents to the growing components of their practices.

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